

REMARKS

Claims 28, 30, 43 and 44 are pending. Claims 1-27 were cancelled in prior papers and Claims 29 and 31-42 are cancelled in this paper. Claims 28 and 43 are amended, incorporating the subject matter of previously presented claims and p. 5, lines 21-23 and p. 11, lines 16-17 of the specification. New Claim 44 is added, incorporating the subject matter of previously presented Claim 12. No new matter is added by these amendments. Favorable consideration of the currently pending claims is respectfully requested in light of the foregoing amendments and following remarks.

Rejections Under 35 U.S.C. § 112 and Amendments to the Claims

All of the previously pending claims were rejected under 35 U.S.C. § 112, first and second paragraphs, as indefinite and as failing to comply with the written description requirement. In addition, several of the claims were rejected as introducing new matter into the claim.

In this paper Claims 29 and 31-42 have been cancelled, Claim 28 has been amended and new Claim 44 has been added. Amended Claim 28 and new Claim 44 generally correspond to previously presented Claims 1 and 12, respectively (with Claim 44 rewritten into independent form and incorporating the subject matter of previously presented Claims 1 and 12). Neither of these previously presented claims had any outstanding rejections under 35 U.S.C. § 112.

Claim 28 has further been amended to recite that the substrate is subjected to a pulsed plasma discharge in the presence of glycidyl methacrylate vapor. Support for this amendment can be found on, *e.g.*, p. 5, lines 21-23 and p. 11, lines 16-17 of the specification.

Claim 30, which was rejected as allegedly encompassing new matter, has not been amended. It is noted, however, that Claim 28, upon which Claim 30 depends, has been amended to remove the recitation that the coating is “continuous,” and thus applicants submit that the time period recited in Claim 30 and described in the specification on, *e.g.*, p. 6, lines

4-6, is sufficiently described in the specification and does not introduce new matter into the claim.

In view of the above, applicants submit that the presently pending claims are not indefinite, comply with the written description requirement, and do not include new matter, and applicants thus respectfully request that the rejections under 35 U.S.C. § 112 be withdrawn.

Rejections Under 35 U.S.C. § 103:

In the Office Action, the Examiner rejected the claims under 35 U.S.C. § 103(a) as obvious over Connell *et al.* (UK 1,037,144) (“Connell”) in view of Timmons *et al.* (5,876,753) (“Timmons”) or vice versa. In addition, the Examiner rejected the claims under 35 U.S.C. § 103(a) as obvious over Timmons in view of Kolluri *et al.* (5,723,219) (“Kolluri”), and Timmons in view of Chabreck *et al.* (WO 98/28026) (“Chabreck”). Applicants respectfully submit that the presently pending claims are allowable in view of the following remarks.

Applicants’ approach during prosecution of this application, pertaining to the central rejections that the claimed method is obvious in view of Timmons in combination with one or more other references, has relied upon claim amendments introducing additional features of the coating or process that were considered to better show the unexpected nature of the claimed method. Notwithstanding these efforts, the present rejections remain. Applicants thus present the following new remarks for consideration.

Applicants believe that the following remarks illustrate a central deficiency of the Timmons reference that is not cured by the other cited references. Accordingly, the present paper does not address in detail each of the arguments presented in the lengthy (37-page) Office Action (which further incorporates arguments made in at least four of the Office Actions that came before it).

The present rejections rely upon an interpretation of the disclosure of Timmons to allegedly show routine application of Timmons to one or more other prior art references, which are considered to show equivalent use of allyl glycidyl ether (AGE) or glycidyl methacrylate (GMA) in certain plasma polymerizations.

Applicants have previously addressed these arguments in a number of ways, but now submit more detailed arguments supporting the previously expressed assertion that the presently claimed method is directed to particular selections (species) of a compound (glycidyl methacrylate or "GMA"), reaction condition (pulsed plasma) and average power density (less than 0.0025 W/cm³) from broad categories (genus) of these features disclosed in the prior art. The presently claimed method has been derived from the surprising and unpredictable result that these selections provide a reactive coating in which the epoxy group content is very close to that which is theoretically possible.

Applicants believe that this result is evidenced by the experiments shown in the application as originally filed and in the additional data of the Declaration filed in December 2008 by Dr. Stephen Coulson, an expert in the field of plasma polymerization (the "Declaration"). While on the subject of the Declaration, applicants note that the Examiner has dismissed a large portion of it as the "opinion" of the declarant. The fact remains, however, that these so-called "opinions" are those of a Ph.D. chemist with over 12 years of experience in the field of pulsed plasma deposition of thin polymer films—Applicants submit that the declarant's statements cannot be properly dismissed simply because they may be Dr. Coulson's "opinions." Dr. Coulson's statements are provided as the statements of an expert in the pertinent field.

Applicants add that, contrary to suggestions in the Office Action, the surprising result does not in itself have to be a feature of the claimed method and submits that all that is necessary in the claims are the features which lead to the surprising result.

MPEP 2144.08 recognizes the patentability of a selected species when the prior art teaches a genus. In order to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), the Office must:

- (A) determine the scope and contents of the prior art;
- (B) ascertain the differences between the prior art and the claims in issue;
- (C) determine the level of >ordinary< skill in the pertinent art; and
- (D) evaluate any evidence of secondary considerations.

MPEP 2144.08(II)(A) (*citing Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)). For a prior art reference disclosing a genus, the following must be considered:

- (A) the structure of the disclosed prior art genus and that of any expressly described species or subgenus within the genus;
- (B) any physical or chemical properties and utilities disclosed for the genus, as well as any suggested limitations on the usefulness of the genus, and any problems alleged to be addressed by the genus;
- (C) the predictability of the technology; and
- (D) the number of species encompassed by the genus taking into consideration all of the variables possible.

MPEP 2144.08(II)(A)(1). While applicants have previously addressed certain aspects of these considerations in previous responses, relevant arguments related to these considerations are more explicitly discussed in the following remarks.

Timmons discloses a new approach to surface modification of solid substrates which involves a two-step procedure consisting of fixing a carbonaceous compound having a reactive functional group to a surface by low power plasma deposition followed by direct addition of a target material to the activated surface by contacting it with a solution of the target material (col. 3, lines 47 to 60).

Timmons' procedure permits deposition of surface functional groups having significantly more chemical reactivity than previously applied (col. 6, lines 1 to 5) as well as control of both the nature and surface density of the functional groups (col. 6, lines 18-22).

Timmons illustrates the procedure with reference to allyl bromide and certain other monomers (*see* the Examples) and teaches that the method has been used for the deposition of other halogen groups, carboxylic acid groups, acid halide or anhydride groups, thiol groups, aldehyde groups and ketone groups on solid surfaces (col. 7, lines 1 to 11).

Timmons emphasizes the successful retention of these reactive groups during low power plasma deposition (col. 7, lines 15 to 28), but declines to define low power because applied electromagnetic power is not easily correlated with the composition of the deposited film (col. 7, 1 to 29 to col. 8, 1 to 5). Timmons adds that the specific low wattage required to retain a specified percentage of functional group will vary with each compound and with other variables (col. 8, lines 35 to 38) and that the important thing is to adjust the plasma deposition conditions to the point at which the desired incorporation of functional group in the deposited film is achieved (col. 8, lines 39 to 42).

Timmons considers that the results show that low power plasma polymerization, particularly pulsed plasma polymerization, can be utilized to provide surface films having an “enormous” range of reactive functional groups (col. 8, lines 51 to 57). Timmons adds that it is clear that the surface fuctionalization could be employed with “virtually any” monomer having a desired functional group (col. 8, lines 58 to 61).

Timmons goes on to teach that “obviously this technology can be extended to include a rich and diverse range of additional functional groups,” and gives a partial listing of functional groups which “could be deposited as intact entities for further chemical derivatizations.” (col. 9, lines 1 to 24).

The listing, which specifically mentions AGE, is limited to allyl type compounds, but Timmons adds that the technology can “obviously” be extended to non-allyl compounds including saturated compounds (col. 9, lines 30 to 32).

Applicants have pointed out and evidenced the speculative nature of this listing—but if it is to be taken seriously, applicants submit that, having regard to MPEP 2144.08(II)(A)(1)(D) (the number of species encompassed by the genus taking into

consideration all of the variables possible), the number of compounds disclosed by Timmons is enormous, and there is only a single mention of a compound that is suitable for depositing epoxy group by low power plasma deposition. There is, in particular, no exemplification of the procedure using that compound and nothing which specifically suggests which other compounds may be suitable. Starting from Timmons, the person of ordinary skill seeking to functionalize a surface with reactive groups for attachment of nucleophilic compounds can choose from a vast number of possible compounds—because all of the functional groups exemplified by Timmons are susceptible to reaction with nucleophiles.

If the person of ordinary skill chose to ignore the exemplified functional groups and instead elected to functionalize the surface with epoxy groups, he or she can still choose from a large number of possible compounds. Suitable compounds may include saturated compounds as well as ethylenically unsaturated compounds. But if he or she were to choose an ethylenically unsaturated compound, there are still a large number of possibilities. The possibilities include all of the glycidyl esters and benzene monoxide compounds mentioned in Claim 1 of the present application as originally filed—as well as, to name but a few, butadiene monoxide, chloroprene monoxide, 3,4-epoxy-1-pentene, 4,5-epoxy-2-pentene, 4,5-epoxy-1-hexene, 5,6-epoxy-1-hexene, 5,6-epoxy-2-hexene, 3,4 epoxy-1-vinylcyclohexene, 1,2-epoxy-5,9-cyclododecadiene, and 5,6-epoxy-1,7-octadiene.

Applicants do not represent that all of these compounds have been used for plasma deposition—but some of them have and they are, according to Timmons, equivalent (in other words, according to Timmons any of these compounds can be suitably selected for plasma deposition). The fact that the Examiner has found documents in which plasma deposition of GMA and/or AGE has been deposited by plasma deposition under other conditions is not, therefore, evidence that the person of ordinary skill would be motivated to select GMA over any other possibility. The Examiner might just as well find other documents which show, for example, plasma depositions of divinylbenzene monoxide. Applicants add that if the person of ordinary skill doubted Timmons, he or she may just as

well find reassurance for a selection of divinylbenzene monoxide from these other documents.

Having regard to MPEP 2144.08(II)(A)(1)(C) (the predictability of the technology), applicants submit that if the person of ordinary skill could not be entirely sure that any two compounds would behave in exactly the same way in the Timmons procedure, he or she would not find reassurance in any prior art which showed that some other compound behaved in the same way as AGE under reaction conditions which are entirely different.

The Timmons procedure is, after all, a new approach and the behavior of structurally similar compounds is so frequently different that equivalence could not be reliably extrapolated between high and low power plasma reaction conditions. In other words, the Timmons procedure is not predictable in the way that is suggested by Timmons.

Applicants have evidenced this in the present application as originally filed. The present application reports the results of two low power experiments (pulsed and continuous wave) for AGE. The results show that AGE either fails to polymerize at all (the pulsed experiment) or it is polymerized without any retention of epoxy groups (the continuous wave experiment). *See* Example 4. Applicants find these results surprising because it might be considered from Timmons that there is some optimum power at which intact epoxy groups can be deposited. (*Id.*).

But Example 4 of the present application suggests otherwise, because it establishes lower and upper power density limits which are very close together. Applicants rationalize this result on the basis that the plasma polymerization is dominated by a free radical addition reaction (and not by the conventional mechanisms of plasma polymerization which dominate the other prior art). The addition of a radical to the double bond of AGE and/or the abstraction of hydrogen atom adjacent the oxygen atom of the epoxy group results in a radical that does not add to the double bond of another molecule of AGE but instead undergoes very fast rearrangement by ring opening of the epoxide group.

The specification of the present application additionally reports the results of two similar low power experiments for butadiene monoxide (pulsed and continuous wave). *See* Example 5. The results also show that butadiene monoxide either fails to polymerize at all or is polymerized with hardly any retention of epoxy groups. *See* Fig. 9. Applicants find this result surprising for the same reason, and rationalizes it in the same way.

The present application further reports the results of two similar low power experiments for GMA. *See* Example 1. The results show that the pulsed experiment leads to very high retention of epoxy group and the continuous experiment does not. *See* Table 1. Applicants find this result surprising because the level of retention in the pulsed experiment is, as compared to other compounds, very high and close to that which is theoretically possible.

Applicants add that the Declaration supports this result when it reports the level of deposition of intact epoxy group by pulsed plasma deposition of GMA at average power densities below 0.0025 W/cm^2 . Applicants thus submit that the present application, as originally filed, evidences the unpredictability in the Timmons procedure in that it reports results which are at complete variance with that which the skilled person is said to expect. Further, the Declaration evidences that near complete retention of epoxy groups is possible by pulsed plasma polymerization of GMA at certain power densities.

Accordingly, applicants submit that, in view of the unpredictability of the technology and the vast number of species disclosed in Timmons, applicants' selection of GMA for the presently claimed method is a nonobvious selection.

Applicant adds that similar considerations apply to the selection of appropriate reaction conditions (continuous wave or pulsed) and average power densities. In this regard, applicants acknowledge that Timmons teaches that pulsed reaction conditions are best for deposition of intact functional groups onto a surface. Timmons does not, however, explain why or show this in relation to compounds containing epoxy groups.

Applicants consider that there are also a great number of possible selections in power conditions because the powers of Timmons' Examples vary so widely. This is especially true when it is considered that Timmons does not mention any power condition at all for either continuous wave or pulsed reaction conditions that can be reasonably considered as a starting point for the deposition of intact epoxy groups onto a surface.

A person of ordinary skill in the art is simply left alone to decide on the appropriate reaction conditions and, in particular, on appropriate power densities for deposition of intact epoxy groups that he or she cannot easily predict.

Applicants thus submit that it is surprising, therefore, that power densities can be found for a particular epoxy group containing compound, which result in deposition of intact epoxy groups at levels that are very close to that which is theoretically possible. It is especially surprising in that Timmons does not claim that such levels can be obtained with any particular functional group, let alone the epoxy group. All Timmons suggests is that plasma deposition conditions can be adjusted to the point at which a desired incorporation of functional group in the deposited film is achieved (col. 8, lines 39 to 42).

Applicants submit, therefore, that the combined selection of compound (AGE), pulsed reaction conditions and the claimed power densities are not obvious in view of Timmons. Moreover, Connell, Kolluri and Chabreck do not remedy the deficiencies of Timmons discussed above.

In particular, applicants agree with the Examiner that the disclosures of Kolluri and Chabreck do not provide a realistic starting point for the making of the claimed method. Applicants assert, however, that neither does Connell, as Connell is concerned with a purpose that does not necessarily require the deposition of intact epoxy groups onto a surface.

The suggestion of AGE by Timmons and the unpredictable behavior of similar compounds evidenced by applicants as well as the selection of appropriate reaction

conditions and power densities for deposition of epoxy groups at levels that are close to that theoretically possible are equally pertinent.

For all the reasons discussed above, applicants submit, therefore, that the presently pending claims are not obvious from any of Connell, Kolluri or Chabreck in view of Timmons.

Finally, applicants note the newly cited prior art of Tatsukami, Mitscher, Hammar and Miura, but do not consider them pertinent following the present deletion of Claims 40 and 41.

For at least the reasons presented above, applicants submit that independent Claims 28 and 44 are novel and nonobvious in view of Timmons in combination with Connell, Kolluri or Chabreck, and applicants respectfully request that the rejections of these claims be withdrawn.

Claims 30 and 43 are dependent on Claim 28 and 44, respectively, and include all of the recitations thereof. As independent Claims 28 and 44 are believed to be allowable, these dependent claims are also allowable, and applicants request that their rejections be withdrawn.

CONCLUSION

Based upon the amendments and remarks provided above, applicants believe that Claims 28, 30, 43 and 44 are in condition for allowance. A Notice of Allowance is therefore respectfully solicited.

No additional fees are believed due; however, the Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment, to Deposit Account No. 11-0855.

If the Examiner believes any informalities remain in the application that may be corrected by Examiner's Amendment, or there are any other issues that can be resolved by telephone interview, a telephone call to the undersigned attorney at (404) 815-6500 is respectfully solicited.

Respectfully submitted,

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